UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:

5HSRM-6J

DEC 0 9 1991

Mr. Ron Lester
WPAFB Remedial Project Manager
2750th Air Base Wing/EMR
Wright-Patterson Air Force Base, Ohio 45433-5000

ATTN: Libby Domingue

RE: Ground Water Sampling for Metals

Dear Mr. Lester:

Several letters have been exchanged between us on the subject of filtered versus unfiltered ground water samples for metals. Most recently, your letter of September 13, 1991, requested United States Environmental Protection Agency (U.S. EPA), Region V Office of Superfund (OSF), to more closely evaluate the issue, not just quote guidance, and to give specific consideration to technical arguments made by Wright-Patterson Air Force Base (WPAFB) in its letter of August 27, 1991.

Many of the sampling techniques in the RI/FS work plan derive from the Resource Conservation Recovery Act (RCRA) Technical Enforcement Guidance Document (TEGD). This is consistent with our Interagency Agreement (IAG) at Section 1 (b). For your information, the TEGD is soon to be superseded by Chapter 11 of SW-846, RCRA ground water monitoring requirements. The Superfund Program considers many of these requirements to be Relevant and Appropriate to CERCLA remedial investigation and remedial action compliance monitoring. U.S. EPA has sent a final draft of this document to the Office of Management and Budget for comment prior to its being published in the Federal Register. Many of the practices allowed or required in the TEGD, such as use of bailers in sampling, and field filtration of ground water samples, have been de-emphasized or revised in SW-846, based on recent technical research on the subjects. Attachment 1 contains pages of this document pertinent to the subject of this letter.

The issues and questions raised in our correspondence on metals sampling have been reviewed in the Office of Superfund's Technical Support Unit, by a toxicologist/risk assessment specialist and a hydrogeologist who is Region V representative to

the Agency's Superfund Ground Water Forum. This response has also been coordinated with U.S EPA Office of Research and Development, R.S. Kerr Environmental Research Laboratory.

In addition to responding to WPAFB's technical justifications in your August 27 letter, I asked the reviewers to evaluate the issues in light of the following questions:

1. What is OSF's position on the technical uses of filtered versus unfiltered data?
2. If metals are to be sampled every round, is it more desirable overall to collect one round of filtered and unfiltered, with the remaining rounds filtered only (the present approach) or have the remaining rounds be unfiltered?
3. From a risk assessment standpoint, are filtered or unfiltered data more useful?

OSF's review and position on the issues follows. Several comments below will require changes in some of the field procedures in the RI/FS work plan.

1. OSF Position on Filtered vs Unfiltered Sample Data Uses

If the purpose of sampling is to determine the concentration of mobile constituents, unfiltered ground water samples for metals analysis is preferred. Chapter 11 of SW-846 states;

> "Ground water samples used to determine if there is statistically significant evidence of ground water contamination shall not be field filtered."

Filtration of ground water samples for metal analyses will not provide accurate information concerning the mobility of metal contaminants. The dissolved metals phase is only a fraction of total mobile metals. Metals may also move through the aquifer as precipitated phases, polymeric species, and adsorbents attached to inorganic and organic particles of colloidal dimensions (generally considered to be less than 10 microns in diameter). Research referenced in Attachment 2 indicates colloids in the 0.1 to 1.0 micron range may be most mobile in a sandy, porous medium. Attempting to measure only the dissolved phases can cause total mobile metals in the ground water to be significantly underestimated. In addition, because a 0.45 micron filter sits in the middle of the size range of mobile colloids, it will trap some and allow others to pass, the result being that neither the truly dissolved fraction, nor the total mobile fraction, are fully determined.

Filtration can create other problems. Field filtration may introduce oxygen into the sample, changing its chemistry; dissolved constituents (e.g., iron) may flocculate or oxidize and precipitate, and be caught on the filter. These constituents may in turn enmesh other, possibly more hazardous metals, removing them from solution. In-line filters, which the procedures at WPAFB call for, minimize the chances of significant oxidation. However, filter loading and clogging of the pores with fine particles does occur, further reducing the ability of mobile species to be collected for analysis. Clay particles enmeshed in the filter may in turn attract and collect mobile species. All these factors would result in an inaccurate measurement of mobile metal concentrations in the ground water.

Historically, filtered sample data have been used to estimate the in situ solution (i.e. dissolved) geochemistry of the ground water. It was assumed that the use of a 0.45 micron filter would separate dissolved and particulate phases, yielding an accurate estimate of the truly dissolved aqueous species concentrations (i.e., free ions, inorganic complexes, and low molecular weight organic complexes). As noted above, research has shown that colloidal material less than 0.45 microns in size may pass through the filter, resulting in significant overestimation of dissolved metal concentrations, whereas it may also filter out mobile colloids greater than 0.45 microns, thereby underestimating total mobile metals. A 0.45 micron filter is therefore unreliable in providing information on metals mobility.

It must be recognized that there are circumstances when a well, despite best efforts (appropriate well construction and well development methods), cannot be developed to achieve the desired visual clarity of ground water. Even with careful sampling (low purging rate and even lower sampling rate), samples might contain suspended particulates that are not actually mobile in the ground water. If data from such wells is critical for estimating contaminant mobility and exposure, RAGS (section 4.5.3) suggests filtration with a 1.0 micron filter may be appropriate. EPA research by Puls and Barcelona (Atch 2) recommends using a 5.0 micron filter to approximate mobile metals, both dissolved and particulate. Because the mobile colloids occur in the 0.1 to 1.0 micron range, Puls now advocates a 2.0 micron filter as the best tradeoff (personal communication, 1991). The filter pore size is slightly larger than the upper end of the mobile colloid range to compensate for reduction in effective pore size due to filter loading.

There can be circumstances, as noted below, where site-specific considerations make field filtration necessary on a

limited basis. For example, in cases where best practices have been implemented, and samples still remain turbid, the most flexible approach would be as follows:

a. Take both filtered and unfiltered samples. Filter through a 2.0 micron filter to best approximate the mobile fraction.

b. Analyze only the unfiltered sample to begin with. If constituents show up at levels of concern (MCLs, risk-based concentrations, etc), analyze the filtered sample to determine the contribution of mobile versus non-mobile particulates. Conversely, if levels of concern are not exceeded, the filtered sample need not be analyzed.

In general, however, field filtration has become a widespread solution to compensate for questionable choice of screened intervals and well materials, improperly executed well construction, or to compensate for sampling techniques that cause unnecessary agitation of the well water.

All efforts must be made in well development and purging prior to sample collection to minimize agitation. This includes the use of low-volume bladder pumps, or peristaltic pumps (in wells where depth to the sampling interval is less than 25 feet). Chapter 11 of SW-846 states:

> "Sampling equipment shall cause minimal sample agitation and shall be selected to reduce/eliminate sample contact with the atmosphere during sample transfer. Sampling equipment shall not allow volatilization or aeration of samples to the extent that analyte concentrations are altered."

Current practice at WPAFB is to use bailers to sample shallow wells. Recent U.S. EPA research on sampling techniques (Atch 3) has shown that analytical results for filtered and unfiltered metals samples, where the well was purged and/or sampled with a bailer, can show significant differences in metals concentrations (below versus above MCLs), whereas analyses of filtered and unfiltered samples collected through low-volume pumps (at a rate less than 1 liter/min) found no significant differences between the two.

2. <u>Protocol for Multiple Sampling Rounds</u>

It can be argued that it is better to take both filtered and unfiltered samples in at least one sampling round (see discussion on risk assessment below). In such a case, in line pressure filtration is best, with as small a filter

pore size as is practically possible (0.05 to 0.1 microns), to remove all suspended material. A comparison of dissolved versus total mobile metals data provides information on the form of the chemical (dissolved or suspended), which is important in understanding the geochemical mechanisms within the aquifer, and is of use in ground water modeling.

However, pragmatic considerations such as streamlining the investigation, cost, and producing data of questionable value, may also influence the decision to collect both filtered and unfiltered samples. Unless a specific data usage is required for dissolved metals data, such as geochemical modeling to support evaluation of a pump-and-treat alternative, OSF will not, as a rule, require collection of filtered samples for metals analysis. However, unfiltered samples will be required, in order to provide data for use in a risk assessment and in remedial design. WPAFB may decide on its own to collect filtered samples for comparison or modeling purposes, to estimate exposure concentrations at critical wells that have high suspended particulates (as noted above), or to comply with the requirements of Ohio EPA policy. In such a case, the filter should be appropriately sized to meet the desired objective.

3. Risk Assessment Perspective

From a risk assessment perspective, RAGS (Risk Assessment Guidance for Superfund) is clear in preferring unfiltered samples (as my letter of 9/4/91 to WPAFB cites). Section 4.5.3, page 4-13 states,

> "If unfiltered water is of potable quality, data from unfiltered samples should be used to estimate exposure".

Potable does not necessarily mean turbidity- and odor-free. As noted in my October 15, 1991, letter to you on the scope of the source control RI/FS at landfills 8 and 10, the quality of water that people will choose to drink will vary with location and economics.

On October 8, I participated in the monthly session of U.S. EPA's Regional Risk Assessment Teleconference for Superfund (RATS) where metals data was the subject. Representatives from all EPA Regions were polled as to what their Regional policies are. From the standpoint of exposure estimation, the unanimous preference was for unfiltered data, consistent with RAGS. Most of the Regions, however, do currently require filtered and unfiltered data for at least one round. If the interval in which a well is screened may not provide a realistic exposure pathway, data from that well may not be

used to estimate exposure. The data may, however, be used to indicate the extent to which contamination may have migrated from a source.

With respect to metals sorbed onto particulate matter in water that is potentially potable, filtration may be undesirable because, should these particulates be ingested, stomach acidity could desorb the metals and they would be available for uptake. Therefore, acidification of unfiltered potable water containing some particulates is likely to be more representative of chemicals available for uptake than a sample from which the particulates have been removed.

4. Soil Data

In paragraph 3a of WPAFB's August 27 letter, WPAFB has argued that significant amounts of analytical soil data from the screened interval of each installed monitoring well exist, and that this data can be used to calculate metals concentrations that would show up in unfiltered samples. This is not correct. Analytical data from the soils will provide information about the distribution of metals in the soils. Such soil data, when combined with analytical data from both filtered and unfiltered samples, may give insight into the geochemistry of, and chemical mobility within, the aquifer, which could be helpful in modeling.

However the issue under discussion is metals in the ground water. Ground water is a separate exposure pathway than soil. We are interested in determining the total mobile metals in the ground water. Mobile constituents of ground water include the dissolved phase and the suspended phase. The suspended phase includes adsorbed species, precipitated species, polymeric species and high molecular weight organic complexes. There is no way to differentiate the mobile constituents from the immobile constituents in the soil. Therefore, the total mobile phase (unfiltered) can not be calculated from the soil data.

5. Fluid vs Particulate Phase

In paragraph 3b of WPAFB's letter of 8/27/91, WPAFB argues that they are concerned with transport of metals in the fluid phase and not the particulate phase. Again, OSF's position is that we are concerned with the transport of all *mobile* metals, both dissolved and suspended.

In the same paragraph, the letter makes the point that ground water flow is not "turbid" in the area of the landfills. The meaning of "turbid" as used here is unclear. If the meaning is that the ground water does not naturally

contain turbidity, this is a strong argument for why filtered samples should not be taken. Clarity does not imply that there are no mobile particulates; consequently unfiltered samples would be preferred. If the meaning is that ground water flow is not turbulent, the point is obscure. Ground water flow is rarely turbulent. Only in karstic limestones and dolomites, cavernous volcanics, and aquifers with wide fractures are flow velocities high enough to entrain sediment by turbulence. Ground water flow is nearly always laminar; laminar flow transports particles.

As you requested, U.S. EPA has now responded to the technical arguments set out in WPAFB correspondence, as well as your suggestion in your September 13 letter that we are applying our guidance dogmatically. Your letter suggested there is no technical justification for unfiltered samples. Rather, it would seem there is more justification (and use) for unfiltered data than for filtered data.

I have discussed U.S. EPA's response with Ohio EPA. As you know, Ohio EPA has a policy that all sampling rounds for metals should be both filtered and unfiltered. It appears that Ohio EPA will continue to adhere to its policy for the time being. WPAFB must therefore find a way to meet both agencies' requirements.

U.S. EPA has spent a great deal of time and effort in responding to this issue you have raised. These requirements necessitate a revised approach to sampling. It may be too late to effect the changes in round 3 at landfills 8 and 10, however, subsequent investigations should follow the above guidelines.

The required changes should be incorporated as an amendment to section 5.8.1.1 of volume 1, section 4.4.3 of volume 2, and appropriate field procedures in volume 2, appendix C of the RI/FS work plan. Please respond with a target date as to when the amendments will be submitted for regulatory concurrence.

Because of the evolving nature of the RI/FS program at WPAFB, we must always be open to new information and new ideas. Those which are based on sound research and principles and which can be incorporated in the program in a timely manner, merit strong consideration if the end result provides a more protective approach without increasing implementation time and costs. If you have any questions, please call me at 312/886-7275.

Sincerely yours,

Wm. Turpin Ballard

Wm. Turpin Ballard
Remedial Project Manager